

Appl. No. 10/605,851
Amdt. dated December 29, 2005
Reply to Office action of September 30, 2005

Amendments to the Specification:

Please replace paragraph [0005] with the following replacement paragraph:

[0005] Although there are many different ways to radiate excess heat, the conventional technology is no longer sufficient to handle the ~~mass~~ massive amount of heat generated
5 by processors and other components. Therefore, many variations of heat dissipation technology have tried to solve this problem. However, no matter how much the efficiency of the fans of the widely employed air-cooling system is improved, there are still some limitations in solving the heat-generation problem. This is especially true for devices like servers for which computing capability is more rigorously demanded. Traditional fans
10 using air-cooling systems require abundant space for heat dissipation. Such a configuration usually requires an additional power supply for it to work. The noise made by the fans also tends to be annoying in closed workplaces. Additionally, fans generate airflow in computer systems. Because the fans are used to expel the generated heat out of the computers, dust or contaminants may go into the computers with the air intake, which
15 contaminates the electronics, causes damage, accumulates inside, and therefore blocks the air-flow and lowers the efficiency of the cooling. Additionally, expensive industry-used computers are unavoidably exposed to environments ~~where it is~~ harder to cool down and cause pollutions of different types. Hence, the life cycle of these computers is shortened. Therefore, for computer systems required to operate at high frequencies in difficult
20 environments, liquid-cooling systems become a kind of important dissipation module.

Please replace paragraph [0006] with the following replacement paragraph:

[0006] Please refer to FIG. 1 showing a block diagram of a liquid-cooling module 12 used in a computer system 10 according to the prior art. The computer system 10 comprises a processor 14, a storage unit 16, and a liquid-cooling module 12. When the computer
25 system 10 is running, internal circuits generate heat, of which the heat generated by the processor 14 is especially influential. Because the internal circuits would be damaged by

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the heat, the liquid-cooling module 12 is used to rapidly expel the heat. The liquid-cooling module 12 contains a heat pipe 22, a pump 24, and a tank 26 which contains liquid coolant. The liquid coolant is driven by the pump 24 and continuously cycles from the tank 26 to the heat pipe 24 (in the direction of arrow A). When flowing
5 through the processor 14, the coolant absorbs and rapidly carries away the heat generated by the processor 14 with its high specific heat to expel the heat from the processor 14.

Please replace paragraph [0007] with the following replacement paragraph:

[0007] However, if the pump 24 malfunctions, the coolant will not be able to smoothly cycle through the tank 26 and the heat pipe 22, and therefore cannot expel the heat from
10 the processor 14. In this situation, the failing of the liquid-cooling module 12 leads to the ruin of the processor 14 and lastly to the break down of the whole computer system 10. Modern operational frequencies of the processor 14 are very high, and the generated heat is quite substantial. Once the liquid-cooling module 12 fails to function, the processor 14 could burn out in just seconds, and the user would not have enough time to respond. How
15 to enhance the structure of the existing liquid-cooling modules to avoid the above situation is a very important topic.

Please replace paragraph [0009] with the following replacement paragraph:

[0009] According to the claimed invention, a computer system includes a processor for processing data, a storage unit for storing data, and a thermal module for dissipating heat
20 generated by the processor. The thermal module comprises a heat pipe adjacent to the processor for conducting heat and a cooling device. The cooling device comprises a plurality of tanks that are connected with each other. The first tank and the last tank of the plurality of tanks are connected with the heat pipe, forming a closed loop. When any of
25 pumps is suspended, a control unit controls the other pumps to run faster to sustain the flowing speed of the coolant in the heat pipe.

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Please replace paragraph [0014] with the following replacement paragraph:

[0014] Please refer to FIG. 2, which shows a block diagram of a computer system 30 according to the present invention. The computer system 30
~~OLE_LINK1~~comprise~~OLE_LINK1~~ comprises a processor 34 for processing data, a
5 storage unit 36 for storing data, a cooling module 32 for expelling heat generated by the processor 34, and a detector 38. The cooling module 32 contains a ~~heat~~ pipe 42, a part of which is adjacent to the processor 34, for transferring heat, and a cooling device 44. The cooling device 44 comprises a plurality of tanks 46 connected serially, a plurality of
10 pumps 48, a control unit 50, an aperture 52, a liquid-in port 54 and a liquid-out port 56. A first tank 46a (i.e. the tank with the liquid-in port 54) and a last tank 46b (i.e. the tank with the liquid-out port 56) are connected with the ~~heat~~ pipe 42 to form a closed loop. At least one pump is capable of being coupled to the plurality of tanks 46. Furthermore, the bottom of the last tank 46b is lower than that of other tanks 46. In this way, compared to
15 the design in which the bottoms of the plurality of tanks are at the same horizontal level, the embodiment illustrated in FIG. 2 has a reduced amount of liquid coolant. The detector 38 is coupled to the last tank 46b for detecting the level of the coolant in the last tank 46b and generating an alert signal if the level of the coolant in the last tank 46b is below a predetermined level. In addition to the last tank 46b, the detector 38 can be also coupled to the other tanks 46. It should be noticed that the predetermined level should be higher
20 than the position of the liquid-out port 56 of the last tank 46b. ~~If there is a lack of liquid~~ If a lack of liquid coolant is indicated by receiving the alert signal, the coolant can be replenished through the aperture 52. The control unit 50 can be a logic circuit or program code stored in the storage unit 36.

Please replace paragraph [0015] with the following replacement paragraph:

25 [0015] When the computer system 30 starts, the control unit 50 enables the plurality of pumps 48 to run. Meanwhile, the coolant driven by the plurality of pumps 48 flows from

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the liquid-out port 56 into the heat pipe 42. When passing through the processor 34, the coolant absorbs the heat generated by the processor 34 and flows toward the liquid-in port 54 of the first tank 46a, which forms a heat-exchanging loop. If the processor 34 generates more heat (for instance, the operating frequency of the processor 34 is increased), the control unit 50 raises the average running speed of the plurality of pumps 48 to accelerate the flow speed of the coolant within the heat pipe 42 to take away more heat generated by the processor 34, which promotes heat dissipation efficiency. For example, when a lot of data is required to be processed, the processor 34 will raise the operating frequency to increase the speed of the data processing. The higher the operating frequency is, the more heat is generated. Therefore, when detecting an increase in temperature (due to an increase of the operating frequency of the processor 34), the control unit 50 drives the plurality of pumps 48 to run faster so as to promptly carry away the additional heat generated by the processor 34. Similarly, when detecting a temperature reduction (due to a decrease in the operating frequency of the processor 34), the control unit 50 drives the plurality of pumps 48 to run slower, preventing extra power consumption. If one of the pumps 48 is detected that it have stopped operating, the control unit 50 accelerates the speed of the other pumps 48 to keep the same heat dissipation rate. For instance, if one of the plurality of pumps 48 shown in FIG. 2 is suspended, the speed of the other two pumps will be raised by 1.5 times to maintain the flowing speed of the coolant. Consequently, the computer system 30 can continue to work normally with the control mechanism of the thermal module 32.